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CONSULTATIVE APPROACH TO BIM IMPLEMENTATION

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Abstract: Building Information Modeling is transforming AECOO industry, it introduces new approaches and new technology as well as collaborative working environment amongst different stakeholders. BIM requires new method of management adapted to the new concept. As a result, a managerial gap within construction industry is created. New skills, expertise and standards have been developed to fulfil the gap. One of the reasons of the shortage of professionals adapted to the new era is the lack of investment in R&D in organizations. One option to bridge the gap in organizations is to involve an external BIM consultancy firm. The role of external BIM consultancy in bridging the gap in Architectural firms is the subject of the research. The objective is to identify the challenges faced by architecture firms in lack of internal R&D and how an external BIM consultancy can bridge the gap. An overview of the literature is discussed, interviews with industry experts verify the concept. The findings approve that lack of R&D in organizations results in lack of skilled professionals which is one of the key reasons of the gap. Other factors such as resistance to change was mentioned as well through the interviews. Recommendations on how to approach the managerial gap are discussed. As well future research related to the subject is proposed.

Keywords: building information management (BIM) implementation, research & development (R&D), external BIM consultancy, resistance to change.

1. INTRODUCTION

According to Coates, Arayici, Koskela (2010) "*BIM is not just another CAD, it is the shift from presenting information about the building to representing this information*". BIM technology allows the users to explore the old method in a new way and it prototypes the design process. BIM provide a new platform that enables interoperability between different stakeholders as well as it supports an integrated project delivery approach.

Based on Eastman, Teicholz, Sacks and Liston (2008) Building Information Modeling (BIM) has its roots in computer-aided design (CAD) research. Transferring from a 2D environment to BIM (3D) requires more than just acquiring different softwares and upgrading hardware. Improving the process of the whole phase of design and construction will reduce problems related to the traditional process in construction industry. There are general steps to be considered when implementing BIM, however each firm has its specific needs and requirements based on its sector. Although the AECOO (architecture, engineering,

construction and owner-operated) is in the early years of BIM implementation, Building Information Modeling has supported and improved many business practices and facilitated a more integrated process that results in better quality buildings.

Autodesk Whitepaper (2008) defines BIM as "*An integrated process built on coordinated reliable information about a project from the design through construction and operations".* Based on McGraw Hill-Construction (2009, 2010) BIM adaption and implementation among major stakeholders across the globe have increased over the past years. Arayici, Kiviniemi, Coates, Koskela, Usher, and O'Reilly (2011) discuss that architectural profession is under pressure to adapt BIM. Since the owners became aware of the benefits of BIM, they started to request BIM on their projects. BIM is an innovative concept in AECOO industry, however, its implementation is not an easy process and usually the firms in different sectors are unaware of the challenges that they can face during its implementation at the level of project or organization (Criminale & Langar, 2017).

2. LITERATURE

The new ideas emerge in construction industry. Crotty (2012) believes that low level of investment in research and development (R&D) is one of the problems within organizations. The digital revolution is changing the nature of not only the construction industry but also other industries, however manufacturing went through those changes sooner than construction industry. Crotty (2012) asks a few questions, such as "what is the nature of the innovation? How rapid is the adaption? What are the benefits? Over the last 60 years of digital revolution, the changes transformed all the sectors, however what Crotty (2012) found interesting is that none of the firms embarked on the adaption consciously. All the sectors first started by resisting to new technology and innovation, however finally they took the innovative step. CAD/CAM (computer-aided design/computer-aided manufacturing) transformed the firms. Innovative process involves the development of technical standards and their adaption by the industry. The process of transformation in the majority of the cases is a progressive one. The firms started to automate one function, the next step was to link the systems, next was integration the groups of functions and then linking the operations and system. The aim of each of those steps was to reduce costs, better efficiency, through innovation and process management. The same steps are happening in construction industry globally and the firms are going through the BIM journey due to the pressure to provide a better service.

Bessant (1995) mentions that technology competence refers to the technological resources, skill and experience. This total package (technological resources, skill and experience) give the firms their distinctive competitive edge. There are various way to built-up those skills, it could be internally, through R&D or other sources. However, the firms need to look at external sources to fulfil the gap in their organizations. Technology transfer is the process through which the technology inter an organization. The transformation of the technology can be in many forms. It could be in form of a hardware, software or knowledge. The multi-dimensional nature of knowledge transfer requires wide ranges of process, policies implication. It is not just through a software training that the transfer will happen. The second

point to consider is that it is time consuming process as it requires several stages. Each stage requires involvement of different parties (participants) as well as different activities to be performed. Bessant (1995) recognize different consultancy players in AMT (Advanced Manufacturing Technology). In the early days of AMT consultancy was dominated by technical and engineering-based consultancies and similar organisations. Below is a list of consultancy agencies:

- Major league management consultancies
- Software and systems houses,
- Hardware and systems suppliers
- Human resource management consultancies
- Universities and colleges
- Training consultancies
- Contract and industry research organizations

According to Bessant (1995) BIM requires a new way of management due to emergence of new technology and new processes. The managerial gap within the AECOO is created and it requires new competencies which can be built-up internally through R&D and/or through external sources; such as professional associations or private external consultancy /external 3rd parties. Technology transfer may be in a physical form or intellectual (knowledge) capabilities. However, technology transfer is a time-based process involving sequences of stages. Many organizations hire external consultancy firms as an intermediary to bridge the gap between the current state and the future state of the organization. The external consultancy input varies from offering of specific technological competencies to skill-specific subjects. However, their involvement goes further than that and it covers the managerial gap as well and the development of internal capabilities (Bessant, 1995). The external consultancy has an important role in bridging the gap in terms of technology and knowledge for the AECOO industry and their input has an impact on the overall advancement of the construction industries.

There are two approaches to consulting that are considered complementary rather than conflicting. First approach presents rather a broad definition of consulting. Fritz Steele defines consulting in this way" *any form of providing help on the content, process, or structure of a task or series of tasks, where the consultant is not actually responsible for doing the task itself but is helping those who are.*". The second approach defines consulting as a professional service and considers a number of characteristics that such a service must possess. According to Larry Greiner and Robert Metzger, "*management consulting is an advisory service contracted for and provided to organizations by specially trained and qualified persons who assist, in an objective and independent manner, the client organization to identify management problems, analyse such problems, and recommend solutions to these people.* (Kubr, 2002). In the research the second definition is considered, however as it mentioned above the two approaches are complementary.

The management consulting, the term used by Kubr (2002) is a method of assisting organizations to improve management and business practices, as well as individual and organization performance. Management consulting can be described as "transferring to clients knowledge required for managing and operating business". The nature of consulting is to create, transfer and apply business knowledge. The term knowledge in addition to theoretical knowledge encompasses experience, expertise, skills, and competencies. As a result the knowledge transfer is concerned both understanding and capabilities for the effective application of knowledge in organizational environment.

Kensek and Peng (2012) in Practical BIM 2012 provide a list of common services by BIM consultants throughout BIM implementation in an organization, some of them are mentioned below:

- Assess the current state of the firm in terms of processes, workflow and setup from actual production work, PD, SD, DD, CDs to internal and external collaboration efforts
- Identify a pilot project provide recommendations based on project deadlines, budget, timeframe and level of complexity
- Define staffing needs
- Provide custom and tailored training based on the project needs
- Develop / Update BIM Standards for the firm
- Develop a Company (BIM software) template
- Pre-Build (BIM Software) project specific content or companywide standard content (walls, doors, windows, schedules, etc.)
- Provide Project Optimization and Evaluation

However, the above list covers the tasks related to the projects and mostly technology oriented.

Azhar, Khalfan, Maqsood (2012) in "Now and beyond" mentions the barriers of BIM implementation relating to different stakeholders in the construction industry. These barriers and risks are categorized into two broad categories; technology-related risks and process related ones. Azhar et al. (2012) summarize the issue related to BIM implementation as;

- Management challenges by the use of BIM
- Lack of guidance on how to implement BIM
- Challenges related to contract documents
- Software firms do not treat the BIM process as a whole, they address certain quantitative aspects of it
- There is a need to standardize the BIM process and guidelines for its implementation
- Challenges related to the ownership of model
- Challenges related to development and operational costs of the model

Eastman (2008) argues that one of the challenges of the firms is how to engage the senior staff and the partners in the new intellectual transition, however when it comes to resistance to change as a barrier, there is no definition or any detail. According to Hammer and Champy (1993, as cited in Coates 2013) the fundamental error made by most organizations is that the technology is seen through the lens of the existing process. Rather than asking '*How can we use technology to allow us to do things that we are not already doing?*' they ask '*How can we use these new technological capabilities to enhance or streamline or improve what we are already doing*? Hiatt (2006, as cited in Coates 2013) developed Prosci ADKAR model, Prosci stands for **Pro**fessional + **Sci**ence and ADKAR means;

A **Awareness** of the need for change
D **Desire** to support and participate in change
K **Knowledge** of how to change
A **Ability** to implement the change
R **Reinforcement** to sustain the change

In this model in fact it is not the organization that changes but rather the individual behaviour changes, people within organizations change. The change in collective behaviour results in different outcomes for the organization. Based on the ADKAR model there is a link between process change and the associated business results. This link is called collection of individual changes and it occurs one person at a time. To manage change both individual change management and organization change management must be used together (The Prosci ADKAR model: Why it works, n.d.). The ADKAR model, does not consider organization management sufficient for change. In fact, it calls it change management and to achieve change management both individual change management and organization change management is necessary and one without the other one does not give result.

As the world changes, organizations need to adapt to the new requirements of the new era. It starts with an uncertainly situation for the organizations and the adaptation requires new-skilled people. The new challenges created by new technology and new approaches push the academic institutions and researchers to undertake actions and exploit the new situation. The construction industry is facing new challenges since a decade ago. There is an unprecedented need for professionals to bridge the gap between the Educational Institutions and different sectors of construction industry. External BIM consultancy is one of the ways to help organizations and provide skills and competences that will enable the Architectural firms to apply new digital transformation and create value through digital design and integrated project delivery approaches (Haron, Marshall-Ponting & Aouad, 2010)

To synthesize, Building Information Modeling is transforming the AECOO industry, it introduces new approaches and new technology as well as collaborative working environment amongst different stakeholders. BIM requires a new method of management adapted to the new concepts. As a result, a managerial gap within construction industry is created. New skills, expertise and standards are created to fulfil the gap. One of the reasons of the shortage of professionals adapted to the new era is the lack of investment in R&D in organizations. One option to bridge the gap in organizations is to involve an external BIM consultancy firm

to fulfil the gap. The role of external BIM consultancy in bridging the gap in Architecture firms is the subject of the research, as per the literature.

3. METHODOLOGY

According to Crotty (as cited in Gray, 2004) there is an interrelationship between different layers of research from epistemology to theoretical perspectives and choice of methodology as well as the selection of methods. Saunders, Lewis and Thornhill (2009) has the same opinion and agrees that prior to data collection and analysis procedures, there are other issues to be consider. Guba and Lincoln (1994, as cited in Saunders et al., 2009) share the same perspective. What is significant to the researchers is to understand the interpretation of ontology and epistemology. Ontology is the study of being or the nature of existence/reality. Epistemology describe a philosophical background, in other words it provides the answer to "what it means to me" or what kind of knowledge are adequate, whereas ontology searches to understand "What is" (Gray, 2004). As Easterby-Smith *et al.* (1991, as cited in Gray, 2004) emphasis, an epistemological perspective has a significant impact on the whole research, first it helps to interpret the issues of research design, rather than just the design of research tools, and secondly a philosophy approach helps the researcher to be able to interpret the situation.

Prior to undertaking research it is necessary to understand the nature of the research (deductive, inductive) and its relation to the practice. Inductive approach is particularly concerned with the context in which the events are taken place, it means the study of a small sample of subjects rather than a large number one, whereas deductive approach is hypotheses testing and describes what is happening. The choice of deductive/inductive has an impact on the research choice of qualitative/quantitative data analysis (Easterby-Smith *et al.,* 2008 as cited in Saunders et al., 2009)**.**

Once the research approach is chosen, the next step is the choice of methodology followed by the choice of research data collection method. Different methodology could be chosen such as survey, case study, etc. Survey option is particularly used to gather the data from the industry experts. For data collection method different options can be chosen, however one of the choice that can be apply to different research approach is interview. The nature of the interviews needs to be consistent with research objectives and the research strategy. Semi-structured interviews is a list of questions or questions and themes, the subject may vary from interview to interview (Saunders et al., 2009). In a research qualitative analysis, the data will be analysed based on the meanings expressed through the words. Requiring classification into categories and the analysis needs to be conducted through the creation of a conceptual frame (Saunders et al., 2009). According to Robson and McCartan (2016) in a qualitative data analysis, findings are presented verbally, and inductive approach is used. The purpose is to understand phenomena in their context and the situation is described from the perspective of the participants, and usually a small scale in terms of number of participants is selected.

The aim of the research is to explore the consultative approach to BIM implementation in Architectural firms. As the research's objective is seeking to interpret how "*humans are in a*

continuous process of social world". The authors decided to choose inductive approach. As inductive approach is particularly concerned with the context in which the events are taken place and it requires the study of a small sample of subjects. Four BIM manager/Design technology managers participated in the interview survey, interviewee A from a global architecture engineering and planning firm with more than 1000 employees around the world. Interviewee B from a Canadian architecture, interior designer firm with 100-500 employees with offices in Canada and outside of Canada. Interviewees C and D from two different Canadian architecture, interior design and master planning firms with 100-500 employees. Interviewee's C firm has offices in Canada and outside of Canada. Interviewee's D firm has offices in Canada. Interviewee's A firm has a R&D department at the headquarters outside of Canada as a result the requirements of the Canadian office were covered by headquarters via videos, webinars etc. The three other firms do not have a R&D department.

4. RESULT AND FINDINGS

The aim of the research is to explore the consultative approach to BIM implementation in Architectural firms. The objective is to identify the challenges faced by architectural firms in lack of internal R&D and how an external BIM consultancy can bridge the gap. The result of the survey can be summarized in three categories;

- Lack of skilled professionals
- External BIM consultancy
- Resistance to change

According to the result of the survey, the main challenge to BIM implementation is the lack of skilled professionals at the level of the project as well at organizational level. At the level of the project, interviewee D mentioned due to the lack of skilled professionals the BIM manager acted as BIM coordinator. At the organizational level the senior project managers did not consider BIM execution plan beneficial to the projects, according to interviewee D. Lack of skills of the new employees was mentioned by interviewee A, which was covered through internal training. Interviewee C mentioned internal online training had been organized regularly by the firm, as well the as existence of an internal BIM community of the employees in the office helped to fulfil a part of the gap.

Due to the lack of skilled professionals in three offices, BIM managers had a wider range of responsibilities than the one with R&D, The BIM managers had to involve as a BIM coordinator, conducting researches, involving in all the aspects of BIM implementation from technology to resistance to change. Interviewees B and D mentioned due to the high cost, their firms did not consider hiring an external BIM consultancy, in addition both demonstrated concern about the fact that the external BIM consultancies are heavily focus on the technology. According to interviewee B "*many of external consultancies are software reseller, as a result the training offered is technology oriented rather than BIM process"*. Interviewee B proposed *lunch and learn* events as one way to approach the issue.

As it was cited by Criminale and Langar (2017), BIM implementation is not an easy process and usually the firms are unaware of the challenges that they encounter during its implementation at the level of project and organizational level. The observation that can be done is that organizations in lack of R&D, do not have a clear view of BIM implementation and all the responsibilities needs to be handle by BIM manager. Practically this is the BIM manager that based on experience and expertise needs to find a solution. Crotty (2012) believes that low level of investment in R&D is one of the problems within organizations.

As per literature review, Bessant (1995) believes that external consultancy can cover the lack of R&D. and gives the example of AMT (Advanced Manufacturing Technology). that in the early days, the consultancy was dominated by technical solutions. That's what is approved through the survey that external BIM consultancy's training is technology oriented, As well it was cited by Bessant (1995) that external consultancies cover both technical and managerial gap, whereas based on the result of the survey, it is only technical part which is covered, which is similar to the early days of AMT. Even considering the list of common services provided by external BIM consultancy in Practical BIM 2012 by Kensek and Peng (2012), it represents a list of technical tasks.

Another subject that came to the surface, was resistance to change. As for decades the work was executed in a certain way, forwarding towards a new process requires time and understanding. Resistance to change by senior project managers, internal interior designers, consultants such as mechanical, structural or landscape architects was a challenge that was cited by all the interviewees. Both interviewees C and D used the word of 'trust' on how to approach the challenge. As it was mentioned through the literature review, Eastman (2008) refers to resistance to change of senior staff and the partners in the new intellectual transition. Coates (2013) propose ADKAR model, as with this model the individual changes is essential to manage change within an organization.

5. CONCLUSION

The research aimed to identify the role of external BIM consultancy in bridging the gap in Architectural firms. BIM requires new method of management adapted to the new concept. As a result, a managerial gap within construction industry is created. New skills, expertise and standards have been developed to fulfil the gap. One of the major reasons of the shortage of professionals adapted to the new era is the lack of investment in R&D in organizations. One option to bridge the gap in organizations is to involve an external consultancy firm.

The study demonstrated the lack of R&D in the organizations as per literature as well as the interviews approved it. Due to the high cost, the firms do not consider investing on external BIM consultancy. In addition, BIM managers are more concerned about the contents of training, these factors confirm that external BIM consultancy need to review the training program proposed to firms. A BIM client in 2019 is different from a BIM client in 2007, the external BIM consultancy needs to answer the particular needs of a client rather than

proposing the same training to all clients, this concept in fact is the foundation of the Lean construction, which is not the subject of this study.

It is recommended that the external BIM consultants broaden their training contents rather than offering the technical solution, which is just a part of BIM implementation. Client's requirements have been widened as they advance in their BIM implementation and external BIM consultancy needs to cover all aspects of information management. As well to reduce the cost of training the external consultant can offer skill-specific training or run *lunch and learn* events.

The new era created by BIM emergence has a direct impact on the organization's management. The BIM manager responsibilities have been amplified and they are not pre-defined tasks, on the contrary it is a cross-section of defined and un-defined tasks. As one BIM manager alone in long-term cannot undertake all the responsibilities and challenges, the organizations need to reflect on how to approach this challenge. In lack of R&D as well as not willing to hire an external consultancy due to the cost or due to the unappropriated training, other approaches need to be considered. One solution as it was mentioned by one of the interviewees is to create an internal BIM community of the employees as an option to fulfil at least a part of the gap.

Resistance to change was another challenge which came to the surface, at the organizational level as well as amongst architectural firms and their consultants. Creating trust between different stakeholders as well as the members of the project team is fundamental for initiating to approach this challenge. The ADKAR model, is one way to approach this challenge. The external BIM consultancy or other type of external management consultancy need to think on how to approach resistance to change.

Future researches need to be conducted on how to bridge the managerial gap by developing an internal R&D or through an external BIM consultancy or other type of external management consultancy. The ADKAR model can be one way to approach the challenge, however other models can be considered as well. Another subject such as the impact of internal R&D in business development is recommended as well.

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